

EFFECT OF VARIOUS SURFACE-ACTIVE AGENTS ON THE PENETRATING POWER AND STABILITY OF CALCIUM HYPOCHLORITE AND BLEACHING POWDER SOLUTIONS

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SOME time ago this Laboratory became interested in the problem of increasing the penetrating power of concentrated solutions of bleaching powder and calcium hypochlorite. It seemed probable that this could be accomplished by the addition of a suitable surface active agent but the hypochlorites are strong oxidizing agents and there was no information available in the literature to guide us in the selection of a penetrant whose surface activity would not be destroyed. It was necessary, therefore, to test a large number of surface active agents and some very interesting results were obtained. Since both bleaching powder and calcium hypochlorite are potentially useful as oxidizing agents in organic synthesis and in sanitation, weed-killing and textile processing, publication of our data was thought worth while even though several years have elapsed since the work was done.

The surface-active agents tested were those which were considered most likely to be suitable for the purpose. There were 130 different products in all, submitted by 32 manufacturers. All the products tested are listed in Table I, each with a parenthetical symbol which designates the manufacturer. The names of the manufacturers corresponding to the symbols are given in Table II.

We determined the "calcium stability values" of all these agents by a modified Hart method (5), but these values were of no use in the selection of good penetrants for hypochlorite solutions.

The lowering of the surface tension in each case was determined with a Cenco-du Nouy tensiometer, but these data were of limited value. All hypochlorite solutions with good penetrating properties had surface tensions less than about 50 dynes/cm. but not all the agents which brought the surface tension below that value proved to be good penetrants (see Tables V and VI). The canvas disk method (4) was tried for measuring the penetrating power of the solutions, but it could not be used because of the high density of the solutions.

The test for penetrating power on which our conclusions are based is the Draves-Clarkson test, which has been adopted by the American Association of Textile Chemists and Colorists as the official method (2).

In this test a 5-gram skein of gray, un-boiled cotton yarn with a metal hook and sinker attached to one end, is immersed in the test solution in a glass cylinder of suitable size. The skein tends to float

TABLE I
Surface-Active Agents Tested^a
(Symbol in Parenthesis Indicates Manufacturer. See Table II)

Acid Soluble Soap R148 (CS)	Oleo Glyceryl Sulfate C (O)
Aerosol AS (ACC)	Oranap (W)
Aerosol AY (ACC)	Orvus (PG)
Aerosol MA (ACC)	Orvus ES Paste (PG)
Aerosol OS (ACC)	Penatrol 60 (B)
Aerosol OT 10% (ACC)	Penequik BT (SS)
Albatex PO (C)	Penesolve (SS)
Alkanol S (duP)	Penetralene BM (SS)
Alkanol SA (duP)	Penetrator 394A (LS)
Alkanol WXN (duP)	Penetrolin AC (ARK)
Ammonium Hexaphosphate Dinitride (V)	Phi-Phi-Sol WA (O)
Aquanol SO (B)	Pineol (ARK)
Arctic Syntex A Powder (CPP)	Product BC (duP)
Arctic Syntex M Beads (CPP)	Pro-so-tex No. 55 (Q)
Arctic Syntex M Liquid (CPP)	Pro-so-tex No. 58 (Q)
Arctic Syntex T Powder (CPP)	Protex Gel (C)
Arylene (HP)	Quaker No. 3X (Q)
Cation Active Compound C (V)	Quaker No. 700X (Q)
Cation Active Compound D (V)	Quix (N)
Cerfak G (H)	Quixite (N)
Charlab Detergent 47-0 (CCL)	Resolin B Paste (SCW)
Chemicharl (CCL)	Sandocarnit (SCW)
Cominol (COM)	Sandopan A Special (SCW)
Daxad No. 11 (DA)	Sandozol N (SCW)
Daxad No. 23 (DA)	Santol No. 1 (CCL)
Detanol (COM)	Santol T (CCL)
Dianol D (Q)	Santomerse D (M)
Duponol ME Dry (duP)	Santomerse No. 1 (M)
Duponol PC (duP)	Santomerse No. 2 (M)
Duponol WA Flakes (duP)	Santomerse No. 3 (M)
Dypenol SE (HP)	Solvadine AL (C)
Emulgol A (G)	Solvadine NC Conc. (C)
Gardinol LS Paste (PG)	SP-302 (S)
Gardinol LS Powder (PG)	SP-702 (S)
Gardinol WA Paste (PG)	SP-703 (S)
Gardinol WA Powder (PG)	Sulfamine 1510 (SS)
Hytergen BM (HP)	Sulfate (G)
Intramix WK (SYN)	Sulphonated Luxolene C-75 (N)
Intramix Y (SYN)	Supergel TB (LS)
Invadine B (C)	Supersulfate FS Powder (LS)
Invadine C (C)	Surfax WO (H)
Invadine N (C)	Tensol No. 5Z (SYN)
Janusol (SYN)	Tergavon C (C)
Lamepon A (CM)	Tergitol O8 (CC)
Lamepon 4C (CM)	Tergitol 4 (CC)
Lanitol AC (ARK)	Tergitol 4T (CC)
Lighting Penetrator X (COM)	Tergitol 7 (CC)
Mercerol (SCW)	Tetranol No. 1638 (ARK)
Modinal D Paste (PG)	Triton NE (RH)
Modinal ES Paste (PG)	Triton 720 (RH)
Mulsor 3CW (SYN)	Triton E-40 (RH)
N-25 (H)	Triton K-60 (RH)
N.S.A.E. Paste (O)	Triton W-30 (RH)
Nacconol NR Flake (NAC)	Ultravon W (C)
Nacconol NRNO Flake (NAC)	Ultrawet D-4 (AT)
Nacconol NRSE Flake (NAC)	Ultrawet 40 (AT)
Naccosol A (NAC)	Unitex (COM)
Nopco 41-5-93B (NOP)	Victor STPP (V)
Nopco 1067 (NOP)	Warcosol 897 (WC)
Nopco 1067 D (NOP)	Warcosol Paste (WC)
Nopco 1067 X (NOP)	Wetsit Single (W)
Nopco DID (NOP)	Wetting Agent No. 35-B (V)
Nopco VOL (NOP)	Wetting Agent No. 58-B (V)
Novonacco (NAC)	Wetting Agent 21529 (CS)
Oil TI-522-25 (N)	Xynomine No. 33 Powder (O)

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^aThe use of a brand name in this publication is not to be construed as a recommendation by the U. S. Department of Agriculture of that particular product over others of the same chemical constitution sold under other trade names. For information about the chemical constitution of these products see list compiled by F. J. Van Antwerpen, Ind. Eng. Chem. 33, 16-22, 740 (1941).

TABLE II

Symbols Used to Indicate Manufacturer^a

ACC =	American Cyanamid and Chemical Corporation
ARK =	Arkansas Company, Inc.
AT =	Atlantic Refining Company
B =	Beacon Company
C =	Ciba Co., Inc.
CC =	Carbide and Carbon Chemicals Corp.
CCL =	Charlotte Chemical Laboratories, Inc.
CM =	Chemical Marketing Co., Inc.
COM =	Commonwealth Color and Chemical Company
CPP =	Colgate-Palmolive-Peet Company
CS =	Commercial Solvents Corporation
DA =	Dewey and Almy Chemical Company
duP =	E. I. duPont de Nemours and Company
G =	Glyco Products Co., Inc.
H =	E. F. Houghton and Company
HP =	Hart Products Corporation
LS =	Laurel Soap Manufacturing Company, Inc.
M =	Monsanto Chemical Company
N =	Naphthole, Inc.
NAC =	National Aniline and Chemical Company
NOP =	National Oil Products Company
O =	Onyx Oil and Chemical Company
PG =	Procter and Gamble Company
Q =	Quaker Chemical Products Corporation
RH =	Röhm and Haas Company
S =	Stanco, Inc.
SCW =	Sandoz Chemical Works, Inc.
SS =	L. Sonneborn Sons, Inc.
SYN =	Synthetic Chemicals, Inc.
V =	Victor Chemical Works
W =	Jacques Wolf and Company
WC =	Warwick Chemical Company

^a The inclusion of a manufacturer's name in this list is not to be construed as a recommendation by the U. S. Department of Agriculture of that particular firm over others in the same field.

in a vertical position until wet, and the more effective the penetrant, the shorter the time required to wet and sink the skein. For our purposes a solution in which a skein did not sink in less than 1800 seconds was considered to have no penetrant action.

For this test, it was necessary to have clear solutions and it was also thought desirable to make the tests on solutions of maximum oxidizing power. For these reasons solubility data were obtained as follows: Various quantities of bleaching powder or commercial calcium hypochlorite were mixed with 100 grams of water and stirred mechanically for one hour. The undissolved solid was then filtered off, and the concentration of hypochlorite ion in the filtrate was determined. For bleaching powder, the A.O.A.C. method (1) was most satisfactory, but for commercial calcium hypochlorite a method in which an excess of potassium iodide is added and the liberated iodine titrated with 0.1 N arsenious oxide proved more suitable (3).

On the basis of the results of these experiments (Tables III and IV), the test solutions were prepared as follows:

CALCIUM HYPOCHLORITE TEST SOLUTION.—This solution was prepared by adding 27 parts by weight of commercial calcium hypochlorite to a solution of 1 part of surface-active agent in 72 parts of water. This mixture was stirred mechanically for one hour and filtered by suction for one hour more. The quantity

TABLE III

Solubility of Commercial Calcium Hypochlorite^a

Weight of sample stirred with 100 grams of H ₂ O	Weight of insoluble residue ^c	Analysis of filtrate ^b	
		Concn. of OCl ⁻ (approx.)	Concn. of Ca ⁺⁺ (approx.)
grams	grams	%	%
10	0.9	4.6	—
15	1.7	6.5	—
20	2.2	8.2	—
25	4.0	9.6	3.8
30	7.0	11.4	—
35	6.0	12.4	—
37.5	7.0	12.7	5.0
40	9.5	12.2	—
50	32.0	11.8	—
70	71.0	9.2	3.5
100	114.0	7.6	—

^a Analysis: Ca, 23.28%; Cl as hypochlorite, 34.94%; Cl as chloride, 8.06%; Cl as chlorate, 0.12%; pH of 1% solution, 11.6.

^b For determination of OCl⁻, see Reference 3; Ca⁺⁺ was determined by oxalate-permanganate method.

^c The apparent discrepancies between weight of sample, weight of insoluble residue and concentration of hypochlorite ion in the filtrate result from retention of water by the precipitate.

TABLE IV

Solubility of Bleaching Powder^a

Weight of sample stirred with 100 grams of H ₂ O	Weight of insoluble residue ^c	Analysis of filtrate ^b	
		Concn. of OCl ⁻ (approx.)	Concn. of Ca ⁺⁺ (approx.)
grams	grams	%	%
25	13	3.7	3.4
30	16	4.0	—
35	26	4.0	4.5
40	39	4.0	4.8
45	44	3.8	—
50	46	3.4	4.7
60	70	3.6	5.8
70	71	3.0	5.8
100	110	3.0	7.3
110	115	3.4	7.8

^a Analysis: Ca, 33.13%; Cl as hypochlorite, 15.02%; Cl as chloride, 16.09%; Cl as chlorate, 0.15%; pH of 1% solution, 12.3.

^b For determination of OCl⁻, see Reference 1; Ca⁺⁺ was determined by oxalate-permanganate method.

^c The apparent discrepancies between weight of sample, weight of insoluble residue and concentration of hypochlorite ion in the filtrate result from retention of water by the precipitate.

of surface-active agent used was thus equal to 1% of the total weight of the three ingredients, and the calcium hypochlorite and water were in the ratio known to give a filtrate of maximum hypochlorite content (approximately 12.7% OCl⁻). In a few cases tests were also made with 0.5, 2 or 3% of surface-active agent present.

BLEACHING POWDER TEST SOLUTION.—This solution was prepared by adding 23 parts by weight of bleaching powder to a solution of 1 part of surface-active agent in 76 parts of water. Subsequent treatment was exactly as described in the preceding paragraph. (Concentration, approximately 4% OCl⁻). Solutions containing 0.5, 2, and 3%, respectively, of surface-active agent were also tested in some cases.

In order to determine the stability of the surface-active agents, each solution was tested three times, first, immediately after filtration, again 3 hours later, and finally 21 hours after filtration. The results are given in Tables V and VI.

During the tests of calcium hypochlorite solutions for penetrant action, it frequently happened that the skein was violently attacked after about five or more

minutes of the test period. This occurred both in freshly filtered solutions and in solutions which had been standing for three or twenty-one hours after the initial test, in which they had shown good penetration. It also happened when no surface-active agent was present. The value of the tests was not affected, because any agent which did not sink the skein in calcium hypochlorite solution in less than five minutes was considered a poor penetrant. Bleaching powder solutions showed little if any tendency to attack the skeins.

In order to determine the effect of surface-active agents on the rate of disappearance of hypochlorite ion, two stock solutions were prepared by mixing (a) 27 parts of commercial calcium hypochlorite with 72 parts of water, and (b) 23 parts of bleaching powder with 76 parts of water. After filtration these stock solutions were divided into portions, and to each was added 1% of one of the five surface-active agents previously shown to be the best penetrants. The concentration of hypochlorite ion in each and in suitable control solutions was determined (1, 3) at intervals during a period of 120 hours. The results of these determinations are shown graphically in Figure 1. From these curves it can be seen that the

TABLE V
Properties of Surface-Active Agent—Calcium Hypochlorite
Solutions of Maximum Oxidizing Power
(Approximate OCl^- concentration, 12.7%)

Surface-Active Agent (in order of effectiveness)	Concn.	Surface tension	Time required to sink skein (6-gram hook used) ^a		
			Immediately after filtration ^a	3 hours after filtration	21 hours after filtration
			seconds	seconds	seconds
Tergitol O8 (CC)	1	27.3	sank instantly	sank instantly	sank instantly
Tergitol O8 (CC)	0.5	29.6	sank instantly	sank instantly	sank instantly
Gardinol LS Paste (PG)	2	29.3	29	36	54
Gardinol LS Paste (PG)	1	40.1	79	108	192
Ultrawet D-4 (AT)	3	33.9	4	9	>1800
Ultrawet D-4 (AT)	2	33.5	9	49	*
Sulfatate (G)	2	33.3	13	69	*
Triton NE (RH)	1	30.0	33	122	*
Product BC (duP)	1	32.2	57	92	*
Sulfatate (G)	1	33.7	78	208	*
Alkanol S (duP)	1	45.8	93	85	>1800
Alkanol S (duP)	2	44.8	15	b	—
Naccosol A (NAC)	1	35.4	104	*	—
Ultrawet D-4 (AT)	1	36.1	167	*	—
Ultrawet 40 (AT)	1	36.1	175	*	—
Naccosol A (NAC)	2	35.4	*	—	—
Arylene (HP)	1	35.5	*	—	—
Invadine N (C)	1	36.9	*	—	—
Emulgor A (G)	1	37.7	*	—	—
Tensol No. 5Z (SYN)	1	38.5	*	—	—
Novonacco (NAC)	1	39.3	*	—	—
N.S.A.E. Paste (O)	1	40.6	*	—	—
Aerosol MA (ACC)	2	42.6	*	—	—
Oleo Glyceryl Sulfate C (O)	1	43.1	*	—	—
Aerosol MA (ACC)	1	50.5	*	—	—

* = Skein was attacked before sinking time could be determined. This occurred from 5 to 25 minutes after immersion.

^a About 2 hours was required for mixing the ingredients and completing the filtration.

^b Violent reaction took place before end of 3-hour period and test could not be made.

TABLE VI
Properties of Surface-Active Agent—Bleaching Powder
Solutions of Maximum Oxidizing Power
(Approximate OCl^- concentration, 4%)

Surface-Active Agent (in order of effectiveness)	Concn.	Surface tension	Time required to sink skein (6-gram hook used)		
			Immediately after filtration ^a	3 hours after filtration	21 hours after filtration
			seconds	seconds	seconds
Tergitol O8 (CC)	2	34.0	sank instantly	sank instantly	sank instantly
Naccosol A (NAC)	2	34.8	8	9	21
Tergitol O8 (CC)	1	38.3	16	17	33
Ultrawet D-4 (AT)	3	40.4	22	16	47
Naccosol A (NAC)	1	37.0	72	94	300
Novonacco (NAC)	1	38.9	75	107	371
Ultrawet D-4 (AT)	2	42.2	208	208	244
Sulfatate (G)	1	43.0	218	167	357
Aerosol MA (ACC)	1	41.3	226	190	312
Tergitol O8 (CC)	0.5	43.5	343	217	373
Alkanol S (duP)	2	50.8	386	427	654
N.S.A.E. Paste (O)	1	36.0	125	1114	x
Arylene (HP)	1	42.5	248	487	x
Emulgor A (G)	1	47.8	317	874	x
Aerosol MA (ACC)	2	43.6	682	580	x
Ultrawet D-4 (AT)	1	49.1	791	669	x
Invadine N (C)	1	37.9	365	x	x
Tensol No. 5Z (SYN)	1	41.2	560	x	x
Alkanol S (duP)	1	54.2	909	x	x
Oleo Glyceryl Sulfate C (O)	1	49.9	1017	x	x
Triton NE (RH)	1	39.7	x	x	x
Product BC (duP)	1	44.3	x	x	x
Sulfatate (G)	1	48.6	x	x	x
Gardinol LS Paste (PG)	1	49.5	x	x	x
Ultrawet 40 (AT)	1	49.6	x	x	x
Gardinol LS Paste (PG)	2	50.2	x	x	x

x = sinking time more than 1800 seconds.

^a About 2 hours was required for mixing the ingredients and completing the filtration.

rate of disappearance of hypochlorite ion in calcium hypochlorite solutions is practically unaffected by Tergitol O8 (CC) and Gardinol LS Paste (PG), but is markedly accelerated by Ultrawet D-4 (AT), Aerosol MA (ACC) and Naccosol A (NAC). The rate of disappearance of the hypo-

chlorite ion in bleaching powder solutions is practically unaffected by the addition of Tergitol O8 (CC), Naccosol A (NAC), Ultrawet D-4 (AT) and Gardinol LS Paste (PG). The last-named, however, has no appreciable effect on the penetrating properties of bleaching powder solu-

tions. On the other hand Aerosol MA (ACC), which initially accelerates the rate of disappearance of the hypochlorite ion of bleaching powder solutions, is apparently oxidized to a product with penetrant properties.

DISCUSSION OF RESULTS.—Of the 130 surface-active agents tested, 113 were completely ineffective as penetrants under the conditions described. The other 17 were effective in varying degrees, as follows:

In calcium hypochlorite solutions of maximum oxidizing power (Table V), prepared with 1% of the surface-active agent, Tergitol O8 (CC) and Gardinol LS Paste (PG) were the only two agents which contributed satisfactory penetrating properties and retained their initial effectiveness long enough to be useful. Triton NE (RH), Product BC (duP), Sulfatate (G) and Alkanol S (duP) were effective in solutions 3 hours old, but after standing for 21 hours these solutions no longer showed improved penetrating power. Freshly prepared solutions containing Naccosol A (NAC), Ultrawet D-4 (AT) and Ultrawet 40 (AT) showed improved penetrating properties, but these properties were lost within three hours, and the first two caused destruction of the hypochlorite.

By varying the proportion of penetrant in these solutions, it was found that the concentration of Tergitol O8 (CC) could be reduced to 0.5% without seriously impairing its effectiveness. Increase in concentration effected a slight improvement with Gardinol LS Paste (PG), Ultrawet D-4 (AT) and Sulfatate (G).

In bleaching powder solutions of maximum oxidizing power (Table VI), Tergitol O8 (CC), Naccosol A (NAC), Novonacco (NAC) and Aerosol MA (ACC) were the only four agents which, when used in 1% concentration, contributed satisfactory penetrating properties and retained their initial effectiveness long enough to be useful. The last-named, however, promotes destruction of the hypochlorite ion. N.S.A.E. Paste (O), Arylene (HP), Emulgor A (G), and Ultrawet D-4 (AT) were fairly effective in solutions three hours old, but after twenty-one hours these solutions no longer showed any more penetrating power than a solution without any surface-active agent. Freshly prepared solutions containing Invadine N (C), Tensol No. 5Z (SYN), Alkanol S (duP) and Oleo Glyceryl Sulfate C (O) showed some improvement in penetrating properties, but after three hours this improvement was lost.

In this solution when the concentration of Tergitol O8 (CC), Ultrawet D-4 (AT), Sulfatate G) and Alkanol S (duP) was increased to 2% or more, their effectiveness was appreciably increased. A concentrated bleaching powder solution containing 2% of Tergitol O8 (CC) is approximately

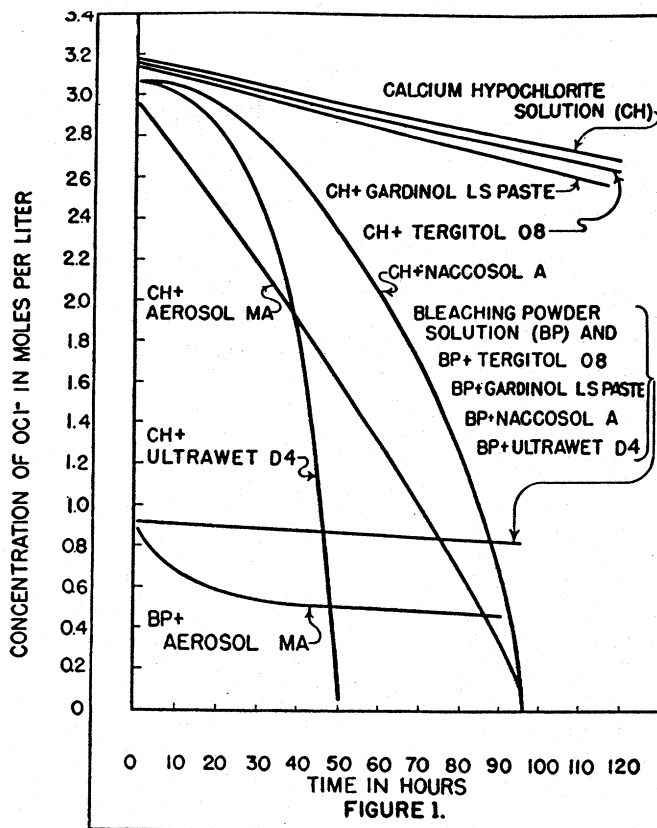


FIGURE 1.

equivalent in penetrating properties to a concentrated calcium hypochlorite solution containing 0.5% of the same penetrant.

Since some surface-active agents, notably Tergitol O8 (CC), are more effective in solutions containing high concentrations of dissolved salts, the most effective penetrants were also tested in more dilute solutions. The results of these tests are given in Tables VII and VIII. From these data it appears that Tergitol O8 (CC) is somewhat less effective in these dilute solutions of calcium hypochlorite than the other agents listed. Its relative effectiveness, however, is better in dilute bleaching powder solutions. This is probably attributable to the presence in bleaching powder of relatively large quantities of salts other than the hypochlorite and suggests that the penetrating qualities of Tergitol O8 (CC) solutions, dilute with respect to the oxidizing agent, can be improved by addition of any compatible salt.

The differences between the effect of Naccosol A (NAC), Ultrawet D-4 (AT) and Aerosol MA (ACC) on the stability of calcium hypochlorite and their effect on bleaching powder solutions, as shown in Figure 1, are striking. The reason for these differences is not known, but a possible explanation is that the active oxidizing ingredient of bleaching powder differs in some fundamental way from calcium hypochlorite.

Summary

Methods are described for preparing clear, aqueous solutions of maximum oxidizing powder from commercial calcium hypochlorite and from bleaching powder.

The effect of 130 commercial surface-active agents on the penetrating power and stability of the above-mentioned solutions was determined. The Draves-Clarkson test was used for the determination of penetrating power.

In concentrated calcium hypochlorite solutions, 0.5% of Tergitol O8 (CC) or 1% Gardinol LS Paste (PG) contributed satisfactory penetrating properties which were retained for 21 hours or longer. Neither showed any tendency to accelerate decomposition of the hypochlorite ion.

In concentrated bleaching powder solutions, 1% of Tergitol O8 (CC), Naccosol A (NAC), Novonacco (NAC) or Aerosol MA (ACC) contributed satisfactory penetrating properties which were retained for 21 hours or longer. When 2% or more of Ultrawet D-4 (AT), Sulfatate (G) or Alkanol S (duP) was used, they also gave fairly satisfactory results. A concentrated bleaching powder solution containing 2% of Tergitol O8 (CC) had approximately the same penetrating power as a concentrated calcium hypochlorite solution containing 0.5% of the same penetrant. Aerosol MA (ACC) accelerated decomposition of the hypochlorite ion.

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TABLE VII

Effect of Penetrants on Dilute Calcium Hypochlorite Solution
(Approximate OCl^- concentration, 2.3%)^a

Penetrant (in order of effectiveness)	Surface tension	Time required to sink skein (6-gram hook used)		
		Immediately after filtration ^b	3 hours after filtration	21 hours after filtration
	dynes/cm.	seconds	seconds	seconds
Ultrawet D-4 (AT)	38.0	4	4	9
Sulfatate (G)	39.2	6	15	15
Gardinol LS Paste (PG)	32.1	11	16	14
Tergitol O8 (CC)	36.0	44	32	47

^a Solution used was the filtrate from a mixture of 50 grams of commercial calcium hypochlorite with a solution of 5.6 grams of the penetrant in 500 grams of water.

^b About 2 hours was required for mixing the ingredients and completing the filtration.

TABLE VIII

Effect of Penetrants on Dilute Bleaching Powder Solutions
(Approximate OCl^- concentration, 1.8%)^a

Penetrant (in order of effectiveness)	Surface tension	Time required to sink skein (6-gram hook used)		
		Immediately after filtration ^b	3 hours after filtration	21 hours after filtration
	dynes/cm.	seconds	seconds	seconds
Naccosol A (NAC)	36.2	5	5	6
Tergitol O8 (CC)	43.7	255	320	280 ^c
Sulfatate (G)	45.0	375	590	916
Ultrawet D-4 (AT)	44.3	302	395	>1800

^a Solution used was the filtrate from a mixture of 50 grams of bleaching powder with a solution of 5.6 grams of the penetrant in 500 grams of water. Although there is a much smaller difference between the hypochlorite ion content of this solution and that of the concentrated solution of Table VI, than between the corresponding solutions of commercial calcium hypochlorite (compare Table VII with Table V), there is much greater difference in the concentration of other calcium salts.

^b About 2 hours was required for mixing the ingredients and completing the filtration.

^c Addition of 5.6 grams Tergitol O8 (CC) at this point decreases the sinking time to 2 seconds.